ELEMENTS
OF
AGRICULTURE
AND
VEGETATION.

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TO WHICH IS ADDED

AN

APPENDIX

FOR THE USE OF

PRACTICAL FARMERS.

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TO THE

RIGHT HONORABLE

JAMES STEWART MACKENZIE,

LORD PRIVY SEAL FOR SCOTLAND.

THE FOLLOWING ATTEMPT IN A SCIENCE

NOT LESS HONORED BY HIS ENCOURAGEMENT

THAN USEFUL IN ITSELF,

IS,

WITH DUE RESPECT AND GRATITUDE,

INSCRIBED

BY

HIS MOST OBLIGED

AND MOST HUMBLE SERVANT,

GEORGE FORDYCE.

ELEMENTS

OF

AGRICULTURE, &c.

PART I.

ELEMENTS OF CHEMISTRY.

Neceſſary to be underſtood for the Explanation of the Principles of AGRICULTURE.

MECHANICS, treat of the Properties belonging indifferently to all kinds of Matter.

CHEMISTRY, treats of thoſe Properties which belong to particular Bodies only, and do not ariſe from their Organization.

PHYSIOLOGY, is the Doctrine of animated Matter, comprehending thoſe properties which the ſame matter has not when dead, and which are neither Mechanical nor Chemical.

SUBSTANCES combine together;

Firſt, MECHANICALLY, by being divided into ſmall Particles, and mixed by *External* Force.

Secondly, CHEMICALLY; by an Attraction of the Particles of one Body to thoſe of another,

The Particles of Bodies do not touch, but adhere by Attraction. Vid. Fig. 1.

MECHANICAL COMBINATION is of two kinds.

Firſt, MIXTURE; when the Particles of one of the Bodies attract one another ſtronger, than they do thoſe of the other; in this Caſe if they be both Fluid, the one which is leaſt in Quantity, is broke down into Spheres; *Example*, As Oil is when mixed with Water. Vid. Fig. 2.

Secondly, DIFFUSION; when the Particles of the one Body, attract thoſe of the other, as ſtrongly, as they do one another, in this Caſe they intermix together equally: *Example*, As Solution of blue Vitriol mixes uniformly with Water; or in the ſame Manner as Serum and Water. Vid. Fig. 3.

In Mechanical Combination, the Properties of the Elements remain exactly the ſame as before the Mixture and the Properties of the Compound depend on them.

When of different ſpecific Gravity, they remain mixed from Friction, and the Attraction of the Particles of the one, in the largeſt Quantity to one another. Vid. Fig. 4.

In CHEMICAL COMBINATION the Subſtances unite by an Attraction, which takes Place between themſelves, without any external Power.

A Particle of each Element unite together, ſo as to form but one Particle conſidered Mechanically. Vid. Fig 5. *Example*,

Nitrous Acid, and Fixt Vegetable Alkali.	Form NITRE, which is to be conſidered Mechanically, as one ſimple Subſtance.

The Properties of the Compound do not depend on the Properties of the Elements.

No Mechanical Power can ſeparate the Subſtances ſo combined.

A Compound may become an Element. Vid. Fig. 7.

* When two Subſtances are to be combined Chemically, we call one of them the *Menſtruum* the other the *Solvend.*

A Menſtruum, will only combine with a certain Proportion of a *Solvend: Example,* Water will only diſſolve a certain Quantity of Salt, and no more.

During the Combination, Heat or Cold are often produced: *Examples,* Vitriolic Acid in uniting with Water, and quick Lime in uniting with Water, generate Heat. Sal Ammoniac and Water, Air and Water, generate Cold.

A Menſtruum will ſometimes diſſolve ſeveral Solvends at a Time, ſometimes only one, as Water will diſſolve ſeveral neutral Salts at once, but an acid will only diſſolve one Metal at a Time.

The Elements remain combined from the Attraction which takes Place between them.

TWO SOLIDS mechanically mixed may be ſeparated;

Firſt, By ELUTRIATION; that is ſeparating two Bodies in Powder by means of Water. If one of the two is of greater ſpecific Gravity, or if the

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* It can be conceived that three Particles, each of a different ſpecies of matter may unite together, ſo as to form one compound Particle ; but there is no given example of this in Chemiſtry, but when a compound contains three elements, two combine, and form a Menſtruum for the third.

Particles of the one, are finer than thoſe of the other, and both inſoluble in Water; if they be mixed with Water, the heavieſt, or that whoſe Particles are largeſt, will ſubſide firſt, and the Water may be poured off while the other is ſtill ſwimming in it. *Example*, Clay and Sand may be ſeparated in this Way; the Clay being finer than the Sand, will remain longer ſuſpended, and therefore may be poured off with the Water.

Secondly, By DISSOLVING one of them in a Menſtruum, in which the other is inſoluble: *Example*, An Acid diſſolves calcareous Earth, but not Sand; therefore theſe two Subſtances may be ſeparated by pouring upon them an Acid, which diſſolving the calcareous Earth, will leave the Sand.

Thirdly, By FILTRATION; if the Particles of the one, are finer than thoſe of the other, by putting them with Water into a Filter, whoſe Pores will let the Particles of the one paſs through along with the Water, the other remaining behind. *Example*, if Sand and Clay be mixed with Water, and poured into a proper Filter, the Clay will paſs through the Water and leave the Sand.

Fourthly, By EVAPORATION, which is the converting a Body into Vapour and diſſipating it. If therefore a fixt and volatile Subſtance be mixed, we may ſeparate them by evaporating the volatile one.

SOLIDS are Subſtances whoſe Particles have their Attraction of Coheſion, ſtronger than the Attraction of Gravitation.

FLUIDS have their Attraction of Gravitation, ſtronger than their attraction of Coheſion.

VAPOURS have their Particles repelled to a conſiderable Diſtance, by a Power, eaſily overcome by an external Preſſure.

HEAT converts Solids into Fluids, and Fluids into Vapour.

Both theſe Changes generate Cold.

Evaporation is in Proportion to the Surface; for external Preſſure prevents it from taking Place ſo readily, and there is the leaſt Preſſure on the Surface. Vid. Fig. 8.

A FLUID Mechanically mixed with a Solid may be ſeparated;

Firſt, By FILTRATION; (i. e.) making the Fluid paſs through a Filter, whoſe Pores will not let the Solid paſs through.

Secondly, By SUBSIDING; (i. e.) if they are of different ſpecific Gravity, letting them ſtand together till the Solid has fallen to the Bottom, or riſen to the Top.

This Separation takes Place more or leſs readily, according to the Difference of ſpecific Gravity, the Size or Number of the Particles of the Solid.

Thirdly, By EVAPORATION; which may be performed when one is more Volatile than the other.

TWO FLUIDS may be ſeparated from one another in the ſame Manner, *viz.*

Firſt, By FILTRATION; when one is more viſcid than the other.

Secondly, By SUBSIDING; when one is of greater ſpecific Gravity than the other.

Thirdly, By EVAPORATION; when they are volatile at different Degrees of Heat.

TWO SUBSTANCES chemically combined, may be ſeparated:

Firſt, By ELECTIVE ATTRACTION; (i. e.) the Application of a third Subſtance, which will unite with one, and ſeparate the other from it.

If calcareous Earth, as Limeſtone be united with an Acid, and fixt Alkali as Pearl Aſh be applied, the Alkali will unite with the Acid, and ſeparate the Earth.

This can only happen when a Menſtruum diſſolves only one of two Solvends at a Time, the one uniting with it, repels the other, and is ſaid to attract the Menſtruum ſtronger.

Two Solvends may attract a Menſtruum equally ſtrongly.

In the following Tables of ELECTIVE ATTRACTIONS, the Menſtruum is placed at the Top of the Column, and the Subſtances it will combine with, are placed under, in ſuch Order, that if any one of them be combined with the Menſtruum, any other that ſtands above it, will ſeparate it; as for *Example*, If Silver be combined with an Acid, Mercury, Copper, an Alkali, or any other Subſtance ſtanding above it, will ſeparate it.

TABLE

Table of ELECTIVE Attractions.

ACIDS.

Phlogiſton,

Fixt Alkali's,

Cauſtic Calcareous Earth,

Cauſtic Volatile Alkali,

Magneſia,

Zinc,

Iron, Lead, Tin,*

Biſmuth, Antimony,

Copper,

Regulus of Arſenic, Earth of Alum,

Mercury,

Silver,

Gold.

Table

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* The comparative Attractions of thoſe in the ſame line are not known; Theſe Tables are ſufficient for our preſent ſubject.

Table of ELECTIVE Attractions.

ALKALI'S, and ABSORBENT EARTHS.

Vitriolic Acid.

Nitrous Acid,

Acid of Amber,

Muriatic Acid,

Acetous Acid,

Volatile Vitriolic Acid, Tartar, Acid of Borax,

Gas, or fixed Air,

Oils.

Table of ELECTIVE Attractions.

METALS.

Muriatic Acid,

Vitriolic Acid,

Nitrous Acid,

Acetous Acid,

Gas, or fixed Air.

This is not the caſe in all the Metals.

Table of ELECTIVE Attractions.

Gas, or fixed Air.

Calcareous Earth,

Alkali's.

Secondly, By HEAT. If two ſubſtances are combined, one of which is fixed, the other Volatile, by Heat we may often deſtroy the Attraction between them, and ſeparate the Volatile one, by converting it into Vapour. If the Acid of Vinegar and Copper be combined ſo as to form Verdigreaſe, if that Verdigreaſe be expoſed to a ſufficient Heat, the Attraction will be deſtroyed, the Acid driven off, and the Copper left.

The Volatile Element cannot be converted into Vapour, until we have applied a ſufficient Degree of Heat to deſtroy the Attraction, although it be Volatile *when ſeparate*, in a much ſmaller Degree.

If a Compound conſiſts of Elements, which are alſo compounded, theſe Elements may be decompoſed by the Heat, and their Elements may alſo unite together, ſo as to form a Subſtance, which was not originally in the Compound expoſed to the Action of the Fire; as for *Example*, If we diſtil Gum Arabic with a conſiderable Heat, there will come over an Oil, which did not exiſt in the Gum.

Thirdly, By COLD; for Menſtruums often diſſolve a larger Proportion of Solvends in Heat than in Cold; therefore in this caſe a Menſtruum is ſaturated with a Solvend in Heat, upon cooling, part of the Solvend will be ſeparated; as if boiling Water be ſaturated with Nitre, upon cooling, part of the Nitre will ſeparate.

SUBSTANCES may act upon one another Chemically.

Firſt, By SOLUTION; when two Subſtances combine together.

Secondly, By PRECIPITATION; when a Solvend unites with a Menſtruum, and ſeperates another from it; or when upon applying two or more Compounds, the Solvends of the one, unite with the Menſtruums of the other.

By Precipitation we do not mean the ſubſiding, but the Chemical Seperation.

Subſtances ſeparated Chemically, require afterwards to be ſeperated Mechanically, by the Means already ſhewn.

Thirdly, By FERMENTATION; i. e. a Change of the Properties of a Compound, without any Addition to, or Separation from, the whole Maſs, but by a new Arrangement of the Elements. Or when a Compound conſiſts of Elements which are alſo compounded; theſe Elements decompoſe one another, and form new ones, which reunite, and produce a Compound, having different Properties from the one, ſubjected to the Operation.

Substances in order to act Chemically upon one another, muſt almoſt always be Fluid, or in the State of Vapour.

Crystallization, is a Diſpoſition in Bodies when they become ſolid, to form themſelves into particular Shapes, and to run in certain Directions.

This Power is capable of overcoming very great Reſiſtances. Hence Water in freezing often breaks the Veſſel in which it is contained.

Salts in Cryſtallizing often take up Water in their Cryſtals.

All Subſtances are capable of Cryſtallization, excepting Animal and Vegetable Mucilages.

PART II.

The PROPERTIES of BODIES neceſſary to be known in AGRICULTURE.

I. Of *SALTS.*

SALTS are Subſtances which will diſſolve in Water, and will not burn; Tartar and its Compounds are Exceptions, as they will burn although they be Salts.

Volatile Alkali and its Compounds are Exceptions, in as far as they deflagrate with Nitre.

Quick Lime is an Exception, which although ſoluble in Water is not called a Salt but an Earth.

SALTS are,

Firſt, SIMPLE or ELEMENTARY, ſuch as cannot be divided into more ſimple Subſtances.

Secondly, COMPOUND, ſuch as conſiſt of other Subſtances more ſimple.

ELEMENTARY SALTS are,

Firſt, ACIDS; ſuch Elementary Salts as unite with Alkalis into neutral Salts.

Secondly, ALKALIS; ſuch Elementary Salts as united with Acids form neutral Salts.

COMPOUND SALTS are,

Firſt, Neutral. Compounds of Acids and Alkalis. *Example,*

Sea Salts conſiſt of { Muriatic Acid,
Fixt Foſſile Alkali.

Secondly, Metallic, Compounds of Acids and Metals. *Example,*

Green Vitriol conſiſts of { Vitriolic Acid
Iron.

Thirdly, Earthy Compounds of Acids and Earths. *Example,*

Selenites conſiſt of { Vitriolic Acid,
Calcareous Earth.

SALTS

NAMES.	The Manner in which they are found or produced.
VITRIOLIC ACID, Synonima, *Oil of Vitriol,* *Spirit of Vitriol,* *Oil of Sulphur,* *Spirit of Sulphur,* *Univerſal Acid,* *Foſſile Acid,*	It is found in the Earth in Sulphur. Sulphur conſiſting of Vitriolic Acid, and inflammable Matter; expoſed to the Air, is decompoſed, the inflammable Matter flying off leaves the acid behind; if therefore there be Sulphur, or any of its Compounds in the Soil, Vitriolic Acid or ſome of its Compounds may be produced. It is produced in the burning of all inflammable vegetable Subſtances, when reduced to a Charcoal. It is the only Acid found in the Air, excepting near the Sea, and where there are large Maſſes of putrifying Subſtances, and it may be attracted from the Air by Alkali's or Earths.

found in SOILS are,

Their PROPERTIES*.

It unites with

Firſt, Fixt vegetable Alkali, forming vitriolated Tartar.

Secondly, Fixt Foſſile Alkali, forming true *Glauber's* Salts.

Thirdly, Iron, forming green Vitriol.

Fourthly, Copper, forming blue Vitriol.

Fifthly, Zinc, forming white Vitriol.

Sixthly, Calcareous Earth, forming Selenites.

Seventhly, Magneſia, forming Magneſia *Glauber's* Salts.

Eighthly, Clay, or Earth of Alum, forming Alum.

It attracts Alkalis and Earths, ſtronger than any other Acid.

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* The whole properties are not laid down here, only ſuch as are uſeful to be known in agriculture.

SALTS

NAMES.	The Manner in which they are found or produced.
NITROUS ACID. Synonimia, *Spirit of Nitre,* *Glauber*'s *Spirit of Nitre,* *Aqua Fortis.*	It is produced by the laſt Stage of Putrefaction and is found either in the putrid Maſs, combined with Calcareous Earth, or Volatile Alkali, or in the Air near it.

found in SOILS are,

Their PROPERTIES.

It unites with

Firſt, Fixt Vegetable Alkali, forming Nitre,

Secondly, Volatile Alkali, forming Nitrous Ammoniac.

Thirdly, Calcareous Earth.

Fourthly, Magneſia.

Its Compounds deflagrate with any inflammable Subſtances, i. e. the inflammable Matter unites with the Acid, and precipitates the Alkali; at the ſame Time there is a great Separation of Air, and a conſiderable Degree of Heat produced.

SALTS

SALTS

NAMES.	The Manner in which they are produced
MURIATIC ACID, Synonima; *Spirit of Salt,* *Glauber's Spirit of Salt,* *Marine Acid.*	It is found in the Earth, in Mineral Waters, and in the Sea combined with the fixt Foſſile Alkali, Calcareous Earth, Magneſia, or Earth of Alum. It is formed by the Putrefaction of Animal, or Vegetable Subſtances, and is found in the putrid Maſs, combined with Calcareous Earth and volatile Alkali. It is found in Soot, combined with Volatile Alkali. It is found in the Air near the Sea.

found in SOILS are,

Their PROPERTIES.

It unites with

Firſt, Fixt Foſſile Alkali, forming Sea Salt,

Secondly, Volatile Alkali, forming common Sal. Ammoniac.

Thirdly, Iron.

Fourthly, Copper.

Fifthly, Zinc.

Sixthly, Calcareous Earth, forming fixt Ammoniac.

Seventhly, Magneſia.

Eighthly, Earth of Alum, forming Alum.

It attracts Metals ſtronger than any other Acid.

SALTS

NAMES.	The Manner in which they are produced.
FIXT VEGETABLE ALKALI *Synonima,* Combined with Air *Salt of Tartar,* *Salt of Wormwood,* *Pot-aſh,* *Pearl-aſh,* *Fixt Nitre,* When free from Gas *Cauſtic fixt Veg. Alkali,* *Common Cauſtic,* *Soap Leys,*	It is formed in the Burning of Vegetable Subſtances, and is found in their Aſhes. It is not an Element of the Vegetable, but is produced from its Elements by the Operation. It is not found in the Aſhes of any putrid Vegetable.

found in SOILS are,

Their PROPERTIES.

It is either free from Gas, or fixed Air, when it is called Cauſtic; or Combined with Gas, or fixed Air, when it is called Mild.

In both Caſes it unites with

Firſt, Vitriolic Acid, forming Vitriolated Tartar.

Secondly, Nitrous Acid, forming Common Nitre.

Thirdly, Muriatic Acid, forming Digeſtive Salt of Sylvius.

It attracts Water from the Air.

When Cauſtic, it diſſolves

Firſt, Oil, forming Soap.

Secondly, Animal and Vegetable Subſtances, forming a Soap.

Both Mild and Cauſtic, it attracts Acids ſtronger than Volatile Alkali, Metals, or Earths.

SALTS

NAMES.	The Manner in which they are found or produced.
Fixt Fossile Alkali *Synonima,* Combined with Air *Natron, ſeu Nitrum Plinii,* *Soda* *Sal Sodæ,* *Barilla,* *Kelp.* When free from Gas *Soap Leys,* *Cauſtic Fixt Foſſile Alkali.*	It is found in the Earth and Mineral Waters, ſometimes pure, ſometimes combined with Vitriolic, Muriatic, or Boracic Acids, or with Sulphur. Upon burning any Vegetable containing Sea Salt, it is found in the Aſhes.

found in SOILS are,

Their PROPERTIES.

It is either free from Gas, or fixed Air, when it is called Cauſtic, or combined with Gas, or fixed Air, when it is ſaid to be mild.

In both Caſes it unites with

Firſt, Vitriolic Acid, forming *Glauber*'s Salts.

Secondly, Muriatic Acid, forming Common or Sea Salt.

It drys in the Air.

It ſeparates Volatile Alkali, Earths and Metals from Acids.

When Cauſtic it diſſolves.

Firſt, Oils, forming Caſtile Soap.

Secondly, Animal and Vegetable Subſtances, forming a Soap.

SALTS

NAMES.	The Manner in which they are found or produced.
Volatile Alkali. *Synonima* When dry and mild *Volatile Salt of Sal Ammoniac,* *Salt of Hartſhorn, Bones, Blood, or any other animal Subſtance,* When diſſolved in Water and mild *Spt. of Sal Ammoniac,* *Spirit of Hartſhorn, &c.* When diſſolved in Water and Cauſtic *Spirit of Sal Ammoniac with Quick Lime.*	It is found in the Juices of Animals, combined with Muriatic, and Phoſphoric Acids. It is found in Soot combined with Muriatic Acid. It is formed in the laſt Stage of Putrefaction, and is found in the putrid Maſs, combined with Nitrous, or Muriatic Acids. It is never found in Soils uncombined, on Account of its Volatility.

found in SOILS are,

Their PROPERTIES.

It is either free from Gas, or fixed Air, when it is called Cauſtic; or combined with Gas, or fixed Air, when it is ſaid to be Mild.

In both Caſes it unites with

Firſt, Nitrous Acid, forming Nitrous Ammoniac.

Secondly, Muriatic Acid, forming common Sal Ammoniac.

Thirdly, Phoſphoric Acid.

When Cauſtic it precipitates Magneſia, Earth of Allum, and all the Metals from any Acid, but not Calcareous Earth.

When Mild it alſo precipitates Calcareous Earth.

SALTS

COMPOUND SALTS are Combinations
Body, when that Compound has the Pro-

NEUTRAL SALTS; or Compounds of Acids

NAMES.	The Manner in which they are found or produced.
VITRIOLATED TARTAR, *Its Elements,* *Vitriolic Acid.* *Fixt Vegetable Alkali.*	It is contained in the Aſhes of all vegetables, and is formed on applying fixt Vegetable Alkali to a Soil, by precipitating a Metal, or Earth, from the Vitriolic Acid, if any Metallic or Earthy Salt be contained in the Soil; or by attracting the Vitriolic Acid from the Air.
GLAUBERS SALT, *Its Elements,* *Vitriolic Acid,* *Fixt Foſſile Alkali.*	It is found native in Mineral Waters. It is produced by the Burning of a Vegetable containing Sea Salt, and is found in its Aſhes.

found in SOILS are,

of any Elementary Salt, with any other
perties of a Salt.

and Alkalis found in Soils, are,

Their PROPERTIES.

It is difficultly ſolluble in Water, requires a great quantity of Water to diſſolve it, and remains dry in the Air.

It diſſolves eaſily in a ſmall Proportion of Water, and dries in the Air.

SALTS

NAMES.	The Manner in which they are found or produced.
Nitre. *Synonima,* *Sal. Peter,* *Elements.* *Nitrous Acid,* *Fixt Veget. Alkali.*	It is formed by applying fixt Vegetable Alkali to a Soil, it precipitating Volatile Alkali, Calcareous Earth, or Magneſia, from the Nitrous Acid.
Cubic Nitre. *Elements,* *Nitrous Acid,* *Fixt Foſſile Alkali.*	It is formed by applying fixt Foſſile Alkali to a Soil, as common Nitre.
Nitrous Ammoniac. *Elements,* *Nitrous Acid,* *Volatile Alkali.*	It is produced by the laſt Stage of Putrefaction.

found in Soils are,

Their PROPERTIES.

It remains dry in the Air, and deflagrates with any inflamable Matter.

Properties the ſame as Common Nitre.

It attracts Water from the Air, it deflagrates with any inflamable Matter, or upon being heated red hot.

NEUTRAL SALTS

NAMES.	The Manner in which they are found or produced.
DIGESTIVE SALT of SYLVIUS. *Elements,* *Muriatic Acid,* *Fixt Veget. Alkali.*	It is formed by applying fixt Vegetable Alkali to a Soil, containing common Salt, or any Ammoniacal, Earthy, or Metallic Salt, with the Muriatic Acid: the fixt Alkali, ſeperating the Volatile Alkali, Earth, or Metal, from the Acid.
COMMON SALT. *Synonima,* *Common Sea Salt* Which is impure containing Salts with Magneſia. *Bay Salt,* *Sal Gem,* *Elements,* *Muriatic Acid,* *Fixt Foſſile Alkali.*	It is found Naturally in the Earth, and in almoſt all Spring Waters; hence almoſt every Soil contains it.
COMMON SAL AMMONIAC. *Elements,* *Muriatic Acid,* *Volatile Alkali.*	It is formed by Putrefaction, and is alſo found in Soot.

found in Soils are,

Their PROPERTIES.

It remains dry in the Air.

It remains dry in the Air.

It remains dry in a dry Air.

SALTS

METALLICK SALTS, or compounds of

NAMES.	The Manner in which they are found or produced.
GREEN VITRIOL. *Elements,* *Vitriolic Acid,* *Iron*	It is formed by the Decompoſition of Pyrites, or is found in Mineral Waters.
MURIA FERRI *Elements,* *Muriatic Acid,* *Iron.*	It is found in Mineral Waters.

EARTHY SALTS, or Compounds of Acids

SELENITES. *Synonima,* *Gypſum,* *Paris Plaiſter.* *Elements,* *Vitriolic Acid* *Calcareous Earth.*	It is found Native. It is formed by Expoſure of Calcareous Earth to the Air, from which it attracts Vitriolic Acid, and is alſo formed by the Precipitation of Magneſia, Earth of Alum, or Metals from Vitriolic Acid by Calcareous Earth.

found in Soils are,

Acids and Metals.

Their PROPERTIES.

It coagulates Vegetale Juices, and hardens their Solids.

It coagulates Vegetable Juices, and hardens their Solids.

and Earths, are

It requires a very large Proportion of Water to diſſolve it, is with difficulty ſolluble in Water, and remains dry in the Air.

EARTHY

EARTHY SALTS

NAMES.	The Manner in which they are found or produced.
Nitrous Selenites. *Elements,* *Nitrous Acid,* *Calcareous Earth,*	It is formed by Putrefaction.
Liquid Shell. *Synonima.* *Fixt Ammoniac,* *Elements,* *Muriatic Acid,* *Calcareous Earth.*	It is found Native, and formed by Putrefaction.

found in SOILS are,

Their PROPERTIES.

It deflagrates, and attracts Water from the Air.

It attracts Water from the Air.

EARTHY

EARTHY SALTS

NAMES.	The Manner in which the are found or produced.
MAGNESIA GLAUBER'S SALTS, Synonyma, *Epſom Salt*, and the *purging Salt of moſt Mineral Waters.* *Elements,* { *Vitriolic Acid,* *Magneſia.*	It is found Native in Soils, and very frequently in Spring Waters, and it is produced by expoſing to the Air, any Neutral Salt, containing Vitriolic Acid, diſſolved in a large Proportion of Water, to the Air,
MOTHER of NITRE. *Elements,* { *Nitrous Acid,* *Magneſia.*	It is produced, by the Expoſure of a Solution of any Neutral Salt, (containing Nitrous Acid) in a large Proportion of Water, to the Air.

found in SOILS are,

Their PROPERTIES.

It attracts Water from the Air.

It deflagrates with any inflamable Subſtance, and attracts Water from the Air.

SALTS

SALTS

NAMES.	The Manner in which they are found or produced.
MURIA MAGNESIÆ*. *Elements,* { *Muriatic Acid,* { *Magneſia.*	It is found Native, and is produced by the Expoſure of a Solution of any Neutral Salt, (containing Muriatic Acid) in a large Proportion of Water, to the Air.
COMMON ALLUM.	It is found Native, and formed by the Expoſure of Clay, containing Pyrites, to the Air.

ALL theſe SALTS prevent Putrefaction, ex-
Magneſia, is one Element; theſe on the other
All COMPOUND SALTS, diſſolved in Water, (ſo
tity of Water in Proportion to the Salt,) and ex-
Neutral Salts the Alkali is converted into Magne-
an Earthy Salt. In the Earthy and Metallick
Earth, or Metal ſubſides, leaving the Water
Spring Water.

This Decompoſition is greatly forwarded by
The *Metallick Salts* are decompoſed in this
Earthy; and the *Neutral* are the ſloweſt in their
All theſe ſalts, except the Alkalis, tend to
late their Juices; the Metallic Salts and Allum
them, the other Earthy Salts and the Neutral

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* It is thirty Years and upwards, ſince I firſt formed Names of the compound Salts; from their Elements but I did not think at the time of the firſt Publication of theſe Element of Agriculture that it would be proper to apply them here as this

found in Soils are,

Their PROPERTIES.

It attracts Water from the Air.

It remains dry in the Air.

cepting thoſe in which Calcareous Earth, or
Hand forward it.
that the Solution ſhall contain a very large Quan-
poſed to the Air, are decompoſed; *viz* in the
ſia, with which the Acid combines, and forms
Salts, the Acid flies off into the Air, and the
pure; hence River Water, *&c.* are purer than

Heat.
Manner the moſt readily; next to theſe the
Decompoſition.
harden Animal and Vegetable Solids, and coagu-
moſt powerfully; next to theſe the Acids; after
Salts are leaſt apt to have this Effect.

Book was indeed only the Notes taken from a courſe of Lectures on the ſubject by one of my Right Honourable Hearers, and deſigned for thoſe only who wiſhed to bring Agriculture to greater perfection, to whom new Names would be unneceſſary and uſeleſs.

INFLAM-

INFLAMMABLE Subſtances

NAMES.	The Manner in which they are found or produced.
SULPHUR. *Synonima,* *Brimſtone,*	It is found Native in the Earth pure; or combined with Metals, particularly Iron, Copper, or Arſenic forming PYRITES; or combined with Calcareous Earth, or Foſſile Alkali forming *Hepar Sulphuris* in fœtid Mineral Waters.
Elements, *Vitriolic Acid,* *Phlogiſton*, (i. e. *Pure inflammable* *Matter.)*	It is found in the Aſhes of Vegetables when they are not burnt white, combined with fixt Alkali, forming *Hepar Sulphuris.*

OIL is an inflamable Fluid, not ſoluble in Water. The only Oil that is ever found in Soils, is *Foſſile Oil*, and that very ſeldom.

found in SOILS.

Their PROPERTIES.

It decompoſes upon being moiſtened and expoſed to the Air in its pure State, and alſo when combined with any of theſe Subſtances, the Phlogiſton flying off into the Air, and leaving the Acid, which unites with any Metal, or abſorbent Earth there may be in the Soil, or with the Clay.

It is inſoluble in Water.

OIL, as a Fluid not ſoluble in Water, would get into the Ends of the Veſſels of Plants, ſhut up their Pores, and prevent the Abſorption of the Water.

EARTHS

NAMES.	The Manner in which they are found or produced.
CRYSTALINE. Synonima, *Flint*, *Sand*, *Gravel*, *Quartz*, *Precious Stones*,	It is found Native, always in Cryſtals, (whole or broke down;) or in Maſſes formed from Cryſtals.
ASBESTIS, TALC. and FUSIBLE SPAR	They are found Native.
CLAY.	It is found Native.

If a Maſs of it be heated red hot, it becomes its Properties cryſtalline Earth.

Soap Earth agrees in its Properties with Clay, fuſible in Water, ſeperates from it with greater Particles.

By Culture, Clay becomes more diffuſible in

found in Soils are,

Their PROPERTIES.

It unites with Acids with great Difficulty.

Combined with Vitriolic Acid it forms Allum.

It is inſoluble in Water.

It is always hard enough to ſtrike Fire with Steel.

It is perfectly inſoluble in Water and Acids.

Its Powder moiſtened with Water, has no Tenacity, nor does it harden when dried or heated by the Fire.

Excepting that they are ſofter, and more friable, they agree with Chryſtalline Earth in Properties.

It is ſoft and in fine Powder.

If it be mixed with water, it forms a tenacious Maſs, which hardens upon drying, and does not diffuſe ſo readily in Water again as Sand.

hard, and burns into a Brick, and reſembles in

of which it is a Species, only it is much more dif-

Difficulty, is of a ſmoother Texture and finer

Water.

The

The Earth conſiſts principally of Strata of theſe Earth are ſometimes found pure, but more comſeldomer find pure Clay, than pure Sand.

ABSORBENT EARTHS

NAMES.	The Manner in which they are found or produced.
CALCAREOUS EARTH. *Synonima,* When combined with Gas. *Animal Earth,* *Marble,* *Limeſtone,* *Chalk,* *Marle,* When free from Gas. *Quick Lime.*	It would appear that the greateſt Part of this Earth is produced from the Exuviæ of Animals, particularly the Shells of Fiſhes. It is alſo produced by burning Animal or Vegetable Subſtances; and by the laſt Stage of Putrefaction. The Earth, ſo produced, did not ſubſiſt in the Animal or Vegetable, (except in the Bones, but is formed by putrefaction.

Subſtances, in which the Clay, and Cryſtalline

monly there is a Mixture of the two; and we

found in Soils are,

Their PROPERTIES.

It may be had combined with Gas, or fixed Air, when it is called *Mild*, or free from Gas, or fixed Air when it is ſaid to be *Cauſtic*,

In both theſe Caſes it unites with,

First, Vitriolic Acid, forming Selenites,

Secondly, Nitrous Acid.

Thirdly, Muriatic Acid, forming fixt Ammoniac.

It will ſeparate any Metal, from any Acid.

Quick Lime or Calcareous Earth free from Gas, is formed from Limeſtone, Chalk, &c. by expoſing them to about a red Heat; the Attraction between the Earth and Gas is deſtroyed, and the Gas driven off.

If the Calcareous Earth be mixed with any other Subſtance, which has the Effect of a Flux, a moderate Heat muſt only be uſed, as otherwiſe the Surface of the Limeſtone would melt, and

ABSORBENT EARTHS

NAMES.	The Manner in which they are found or produced.

form a Cruſt, which would prevent the Evaporation of the Gas: This is to be known, by throwing a Piece of the Stone into a common Fire, and blowing againſt it with a Pair of Bellows; if there be any ſuch Subſtance, the Surface will melt.

A white Heat for the above Reaſon is too great to burn any Limeſtone with.

Calcareous Earth, produced by the burning of any animal Subſtance, cannot be burnt into Lime, except it be firſt diſſolved in an Acid, and ſeparated by an Alkali.

Quick Lime, like dry Neutral Salts, unites with Water, and Cryſtallizes, and the Cryſtals in ſhooting break down the Maſs, and ſeparate from one another, ſo that the whole appears to fall into a fine Powder; and if one Third of the Whole conſiſts of Lime, it is ſufficient to break down the remaining Part; hence, if Limeſtone contain one third Part of Calcareous Earth, it may be burnt into Lime; or if it conſiſt wholly of Calcareous Earth, and one third Part of it be burnt, it will fall down; and Lime is ſeldom thoroughly burnt.

ABSORBENT EARTHS

NAMES.	The Manner in which they are found or produced.

found in SOILS are,

Their PROPERTIES.

If Limeſtone contains no other abſorbent Earth, except Calcareous, the Quantity of that Earth, is known by throwing one hundred Grains into an Ounce of Muriatic Acid, diluted with four Ounces of Water, letting the whole ſtand till there is no more Efferveſcence, throwing what remains into a Filter; when the Fluid has filtrated through, pouring upon what remains half a Pint of Water, letting that Filter off alſo, then drying and weighing what is left in the Filter, the Weight loſt gives the Proportion of the Calcareous Earth.

If there be any other Abſorbent Earth, upon pouring into what filtrated through two Ounces of Cauſtic Volatile Alkali, a Precipitation will take place; this Precipitate is alſo to be ſeparated by Filtration, and its Weight deducted from the Calcareous Earth.

The Quantity of Lime burnt is known, by putting one hundred Grains into a filtrated Solution of two Ounces of Sal Ammoniac in half a Pint of water, boiling them together in a Glaſs, or

ABSORBENT EARTHS

NAMES.	The Manner in which they are found or produced.

or Stone Veſſel, for an Hour, or until there is no ſmell of Volatile Alkali; taking Care to add Water as the former evaporates; afterwards filtrating what remains; after the Filtration, pouring upon what is in the Filter, half a Pint of Water, letting that Filter off alſo; then drying and weighing what remains in the Filter, the Weight loſt is the Lime burnt.

If Calcareous Earth is found in a looſe Maſs, ſo as to break down very readily, it is with Difficulty burnt into Lime, as the Fuel can hardly burn if mixed with it; and if it is mixed with Clay, it will burn into a Brick, which will both prevent the Evaporation of the Air, and the falling of the Lime; in both theſe caſes it is called Marle.

Calcareous Earth, when mixt with Clay, gives a greater Friability to it than Sand does; hence Marle falls eaſily down in Water.

Quick Lime diſſolves in Water in the Proportion of about five Grains to a Pint.

ABSORBENT

ABSORBENT EARTHS

NAMES.	The manner in which they are found or produced.

found in SOILS are,

Their PROPERTIES.

It unites with Sulphur, forming *Hepar Sulphuris.*

It unites with Animal and Vegetable Subſtances, forming a Soap.

It prevents Putrefaction.

It attracts Acids ſtronger than Volatile Alkali or Magneſia.

If it be expoſed to the Air, it attracts from it the fixable Air, and reverts to the State it was in before it was burnt.

Mild Calcareous Earth, forwards Putrefaction.

It is inſoluble in Water.

When Calcareous Earth is reduced to a Powder, and applied to a Soil, it is apt to be waſhed through it.

Cauſtic Volatile Alkali will not precipitate Calcareous Earth, if diſſolved in an Acid; but fixt Vegetable Alkali will; this diſtinguiſhes it from the other Earths.

Vitriolic Acid will not diſſolve it ſo as to form a clear Solution; and if this Acid be added to a Solution of it in any other, it will make a Precipitation.

ABSORBENT EARTHS

NAMES.	The Manner in which they are found or produced.
MAGNESIA.	It is produced by the Decompoſition of any Salt containing Magneſia, by Expoſure to the Air, or applying to it an Alkali, or Cauſtic Calcareous Earth.
EARTH of ALLUM.	It is produced by the Decompoſition of Allum, and is in fact argillacious Earth, either ſeparated or altered, by being combined with an acid, and in a ſoil is to be conſidered as very different, as it eaſily unites with any Acid it may find, and forms a Salt very poiſonous to Plants.

found in Soils are,

Their PROPERTIES.

It may be had combined with Gas, or fixed Air, or free from Gas, or fixed Air.

In both Caſes it unites with

First, Vitriolic Acid, forming Magneſia Glauber's Salts.

Secondly, Nitrous Acid.

Thirdly, Muriatic Acid.

It is inſoluble in Water.

It aſſiſts Putrefaction.

It may be had free from Gas, or fixed Air, or combined with Gas, or fixed Air.

In both Caſes it unites with Vitriolic Acid, forming *Allum*.

AIRS,

AIR is a VAPOUR not condenſible in bination.

AIR is of ſeveral Kinds, *Viz.*

NAMES.	The Manner in which they are found or produced.
Respirable Air.	
Fixable Air.	
Inflammable Air.	

There are alſo ſeveral other Kinds of Air.

the Heat of the Atmoſphere without Com-

Their PROPERTIES.

That which ſerves for the Life of Animals and * Vegetables, and Inflammation of Fuel.

That which is contained in Alkalis, and Abſorbent Earths when they are Mild. It will neither ſerve for the Reſpiration of Animals, nor Vegetables, nor the Inflammation of Fuel, but it is not poiſonous.

Separates from Metals while they combine with Acids, is often found in the Earth near Mines, and is poiſonous to Plants.

Animal

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* It has lately been ſuppoſed to be pernicious to Vegetables; but no dependance can be had in experiments made by making Plants grow in Glaſs Bottles, or under Receivers; ſince we find that a Plant ſhut up in a Green Houſe, 100 Feet by fifty, and covered entirely with Glaſs, will not grow to any perfection, if the doors and windows are kept cloſe ſhut.

Animal and Vegetable SUBSTANCES.

NAMES.	The Manner in which they are found or produced.
ANIMAL FIBRES.	
VEGETABLE FIBRES.	
VEGETABLE and ANIMAL MUCILAGENOUS JUICES.	
BITTER, ASTRINGENT, RESINOUS, *&c.* JUICES of VEGETABLES.	

found in SOILS are,

Their PROPERTIES.

Diſſolved in Water, form a Solution, which Jellies.

They form when diſſolved in Water, a Solution which is Gummy.

They form a gummy Solution in Water, but if putrified, a Gelatenous one.

They prevent Putrefaction.

Animal and Vegetable SUBSTANCES

NAMES.	The Manner in which they are found or produced.
MUCILAGE.	It is produced by the Putrefaction of Animal or Vegetable Subſtances and is applied to Soils in Firſt, The Dung of Animals. Secondly, Putrid Animal or Vegetable Fibres or Juices. Thirdly, The Roots of Plants, if they putrify in the Soil. Fourthly, The Exſudation from the Roots of the Plants, growing in the Soil, if it putrifies. Fifthly, The Inſects in Soils, if they putrify. Sixthly, The Dung of the Inſects. Seventhly, The Animal and Vegetable Subſtances contained in Rain Water and Dew, if they putrify.—There are two Stages of Putrefaction, the firſt produces Mucilage, the ſecond converts it into Calcareous Earth, Muriatic and Nitrous Acids, and Volatile Alkali.—Vegetable Subſtances, before they putrify, go through the Sacharine, Vinous, and Acetous Fermentations, but Animal Subſtances putrify immediately.—Two, or more of theſe Fer-

found in SOILS are,

Their PROPERTIES.

Gives Viſcidity to a large Proportion of Water.

It prevents the Evaporation of Water.

It gives Tenacity to Sand, and Friability to Clay.

It cannot be ſeparated from Water by Filtration.

Fermentations, may go on in the ſame Maſs, at the ſame Time; as for Example; What is already converted into Wine, may be converted into Vinegar, while another portion of the Maſs is converting into Wine.—The Sacharine, Vinous, and Acetous Fermentations, generate Heat, but the Putrefactive does not.—In order that any Subſtance ſhould be formed by a Fermentation perfectly, it is neceſſary that the Operation go on neither too faſt, nor too ſlowly.—The Subſtances forwarding Putrefaction increaſe the Quantity of Mucilage, by making Animal or Vegetable Matters putrify, which would either not have putrified at all, or which ſhould have putrified too ſlowly. But they alſo tend to deſtroy it, by making the Mucilage proceed to the ſecond Stage of Putrefaction, and ſo convert it into Earth and Salts.

They tend more to forward the firſt, than the ſecond Stage of Putrefaction.

found in SOILS are,

Their PROPERTIES.

PART III.

The STRUCTURE and OECONOMY of VEGETABLES, neceſſary to be known in AGRICULTURE.

THE principal Veſſels of Plants are of two Kinds, *Tubes* and *Cells*.

The TUBES run from the Roots to the different Parts of the Plant in ſeparate Bundles, communicating with one another, but not joining and branching, as in Animals.

Theſe Tubes contain principally the mucilaginous and ſacharine Juices, ſerving for the Nouriſhment of the Vegetable.

The Tubes being capillary, if empty, and emerſed in Water, or any other Fluid, have a Power of filling themſelves by the Attraction of their Sides to the Fluid; but this will not by any means account for the Circulation in Vegetables: There is therefore a Power ſimilar to the muſcular Power in Animals, by which this Motion (at leaſt in Part) and all the other Motions of Vegetables are performed.

The CELLS contain the peculiar Juices of Plants, and moſt probably theſe are formed in them by Fermentation: They communicate with the Tubes, or rather the Tubes terminate in them.

In the Root of a Plant the Cells ſurround the Tubes, which are only open at the extreme Points of the Fibres, and Fluids cannot be abſorbed by them any where elſe.

The Tubes are not ſimply open at the End of the Fibres, but there is a particular Configuration, which adapts them to abſorb Fluids; ſo that if the Ends of all the Fibres of the Roots of any Vegetable be cut off, the Growth of that Vegetable is ſtopped, till freſh Fibres are formed.

Unleſs there be a number of Fibres in the Root, a Plant will ſeldom flouriſh, inaſmuch as a ſufficient Quantity of Nouriſhment cannot be abſorbed.

More numerous Fibres may be made to break out by.

A ſufficient Tenacity in the Soil;

Richneſs of Soil;

Cutting the Fibres; in which caſe they do not go on, but branch out into new ones;

Poiſoning the weak Fibres, and

Cutting the Branches.

But the Fibres are rendered too weak for the Support of the Plant, by

Too great a Tenacity of the Soil;

Applying Poiſon in too great a Quantity; and

Cutting the Branches too much.

As Roots can only abſorb Nouriſhment from the Points of their Fibres, the Cells ſurrounding them ſerve to defend the Tubes from Water, which they do, if the Soil be moderately dry; but in very moiſt Soils, the Water ſoaks through to the Tubes, ſtops the Circulation in them, and rots them.

The Roots of ſome Plants will bear a much greater Quantity of Moiſture than thoſe of others.

In Trees and Shrubs, the Stems, which are above a Twelvemonth old, are to be conſidered as Roots, having the ſame Structure.

At that Part where the Root is converted into a Stem, the Tubes devaricate, and are placed on the Outſide; being covered only with a thin Bark, which is of the ſame Texture, and anſwers the

Purpoſes of the Leaves, the Cells forming the Pith, being contained in the middle.

Water conſtantly evaporates from the Leaves and the Bark of the Stem, and carries along with it the volatile Parts of the Juices, and ſome ſmall Portion of the more fixed; but they attract Water from the Atmoſphere at the ſame time, ſo as in ſome Caſes to nouriſh the Plant totally, and the Roots alſo throw out a Part of the Juices into the Ground.

There is a conſiderable Difference betwixt that which evaporates into the Air, and that which exſudes into the Ground; as the former contains Water with the eſſential Oil of the Vegetable, and the latter the mucilaginous Juices.

The Exſudation from the Roots takes Place in the greateſt Quantity,

Firſt, While the Leaves are flouriſhing, hardly any thing flowing out after they begin to decay.

Secondly, In Plants that are moderately ſucculent.

Thirdly, In perennial Plants, at the Time of the flowing of the Sap.

Of the GROWTH of PLANTS.

A SEED conſiſts of

The HUSK, a Membrane covering the other Parts.

The COTYLEDONS, one, two, or three Maſſes of farinaceous Matter.

The EMBRYO (i. e.) the young Plant, conſiſting of a *Radicile* and *Plumule*.

The EMBRYO lies in a dormant State (i. e.) alive, but not exerting its Life, until it is put in proper Circumſtances; which are

of { Heat,
Moiſture, and
Expoſure to the Air.

It requires different Degrees of theſe to make different Seeds grow.

The Embryo may die.

Firſt, If a Seed once begins to grow, and is ſtopped, the Embryo dies.

Secondly, The Embryo may alſo die from Age (i. e.) if the Seeds are kept too long; and in ſome Seeds, this happens in twelve Months, in others not in twelve Years.

Thirdly, Or it may be deſtroyed by Inſects.

Fourthly, Or it may undergo Fermentations from Moiſture.

Fifthly, Or it may be killed by Poiſons.

In all theſe caſes the Vegetation of the Seeds is deſtroyed.

When a Seed is put in the proper Circumſtances for growing, the farinaceous Matter in the Cotyledons is converted into Sugar, the Embryo ſwells, and the Radicile puſhes forwards, till it gets through the Huſk, and afterwards runs perpendicularly downwards, till it breaks out into Fibres.

Theſe Fibres run in different Directions, but never penetrate above a certain Depth from the Air.

The PLUMULE, when the Radicle has got into the Earth, riſes upwards; ſometimes bringing along with it the Cotyledons, which are in ſome Caſes converted into the Seed Leaves.

During this Time the Plant is nouriſhed principally by the Cotyledons; for if the Root be deſtroyed, the Plumule will riſe up, and when it gets above Ground, and its Leaves ſpread, freſh Roots will be thrown out.

If a Plant be cut off below the Cotyledons, it will hardly ever puſh out freſh Leaves, but it rots, and is deſtroyed; on the other hand, if it be cut off above the Cotyledons, it generally ſhoots afreſh, and continues to grow; therefore, if Plants, whoſe Cotyledons come above Ground, as Turneps, be cut, or eat to the Ground by any Animal, they decay; but if ſuch, whoſe Cotyledons remains below Ground (the Graſſes for Example) are cut, they will ſhoot out afreſh.

After the Plumule is come above Ground in the Graſſes, there is a Knot or Swelling formed above the Cotyledons, where the Stem divides into, or throws off, ſeveral Branches and freſh Roots; and as ſoon as the Leaves of theſe ſpread, the firſt Root dies. This is called *Tilluring*.

Theſe Branches are more or leſs numerous, according to

The Richneſs of the Soil;
The Tenacity of it;
The Room the Plant has to grow in;
The Moiſture of the Soil; and
The Earlineſs of the Seaſon.

Each of theſe Branches may be made to divide a ſecond Time,

By ſowing the Seed early in the Autumn; it in this Caſe branching out, in the Autumn, and again in the Spring;

By cutting the Stem;

By cutting the Roots;

By Tranſplantation;

By great Moiſture in the Soil; hence Corn, after it has flowered, will ſometimes branch out a ſecond Time after heavy Rains.

If a Graſs be made to branch out a ſecond Time, in a poor Soil, or a dry Seaſon, the Branches are apt to run up weak.

Moſt perrennial Plants (excepting Trees and Shrubs) become ſo by branching out afreſh every Autumn, the old Roots and Plants dying.

ROOTS puſh forward with conſiderable Force, which however is not equal in all Parts; and a ſufficient Reſiſtance ſtops them, and makes them branch out laterally.

If the Reſiſtance from the Tenacity of the Soil be too great, they break out into a vaſt Number of Branches, too weak to ſupport the Plant; and if too little, they run out into long Fibres, having too few Ends or Mouths to abſorb ſufficient Nouriſhment.

The Root always runs where there is the leaſt Reſiſtance.

The STEMS go on flouriſhing more or leſs, according to

First, The Moiſture of the Soil;

Secondly, The Heat;

Thirdly, The Soils being adapted to the Roots;

Fourthly, The Richneſs of the Soil, and its Freedom from noxious Subſtances;

Fifthly, The Time the Seed has been kept, *viz.* the ſhorter the Time it has been kept, the more luxuriant the Plant.

The STEM puſhes out from it the FLOWER-STEM, which ariſes either laterally as the Leaves ſpread, as in Peas; or terminates the Stem; And in this Caſe either there is only one, as in Graſſes; or ſeveral, as in Turneps and Cabbages.

When the Flower-Stem ariſes laterally, the Leaves continue to flouriſh after the Flower is dropped off, and of conſequence until the Seed is perfected, and the whole Plant dies; but when the Flower-Stem is terminal, the Leaves begin to wither as ſoon as the Flower drops off. Hence, as the Nouriſhment is taken entirely from the Ground, without any Exſudation of any thing imbibed from the Air into it, after this Period, Graſſes and other Plants having terminal Flowers, enrich the Soil till they flower; but afterwards impoveriſh it, perhaps in ſome Degree in Proportion to the Weight of the Seed.

In Graſſes no new Leaves ſpring out from the Stem after the flowering; and thoſe which have already ſprung out, begin to loſe their Juices, and decay.

GRASS ſhould therefore be cut for Hay as ſoon as it is fully in Flower. Different Graſſes flower ſooner or later; therefore if two Graſſes grow on the ſame Field, either one or other muſt be cut too ſoon or too late.

All Plants have Male and Female Parts of Generation; the *Chives*, or Male Part; the *Pointal*, or Female Part.

The CHIVES are Bags, containing a Powder; they open juſt as the Flower opens, and the Powder impregnates the Female Part.

This Impregnation is prevented,

Firſt, By Cold;

Secondly, By very violent Rains;

Thirdly, By Weakneſs of the whole Plant;

Fourthly, By Weakneſs of the Roots; ſo that in moiſt Soils, or very rainy Seaſons, when the Plant appears to be flouriſhing greatly, and a ſufficient Quantity of Flowers are thrown out, the Impregnation does not take Place, and the Seed or Fruit either drops off entirely, or is ſmall and ſhrivelled, the Roots being rotted by the Moiſture.

Fifthly, By the waut of Air.

When the Leaves and Stem of a Plant flouriſh greatly, it ſeldom produces many Flowers.

In Graſſes, as the Nouriſhment is drawn from the Roots after they flower, if the Roots are rotted by Moiſture, the Seeds will not be perfected: In the ripening of the Seed, the farinaceous Part of the Cotyledon is produced.

Plants cannot live without AIR; it produces probably the ſame effect in them that it does in Animals.

The Action of the Air appears to be principally on the ſmooth Surface of the Leaves, or the Bark of the Stem.

The Air is rendered effete * by the Plant; ſo that there muſt be a continual Supply of freſh Air, otherwiſe the Stem runs out to a great Length, is exceedingly ſmall and weak, the Leaves endeavour to ſpread out to a great Diſtance, no Impregnation takes Place in the Flowers, the proper Juices are not formed, and the whole Plant is deſtroyed.

Hence, if ſeveral Plants are ſown in a Soil, thoſe which are beſt adapted to it will grow up ſtrongeſt, rob the others of the Air, and deſtroy them.

The Roots alſo require Air; ſo that if a Root be planted too deep, it will not grow, and different Roots require alſo different Degrees of Expoſition.

It is only reſpirable Air that will effect theſe Purpoſes.

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* This Doctrine has been much controverted, by thoſe who have ſought the knowledge of Plants from Experiments on them, when growing under Receivers.

LIGHT is alſo neceſſary for the Growth of a Plant, but not ſo much ſo as Air.

Moſt Leaves have two Surfaces, one of which is always expoſed to the Light; and if the other is turned to it (by altering the Poſition of a Branch) the Growth is frequently ſtopped, until the Leaves turn themſelves to it again.

This ſmooth Side of the Leaf therefore, being that which is acted upon by the Air and Light, would appear to be that Part by which a Plant principally lives; and in many Plants the Leaves ſhut themſelves up, ſo as to cover this ſmooth Side on Expoſure to cold Air, noxious Vapour, Darkneſs, or even upon being touched.

The Want of a ſufficient Quantity of Light, prevents the Plant from forming its proper Juices (except Mucilage and Sugar) deprives it of its Blue Colour (the Green conſiſting of Blue and Yellow) leaving it either Yellow or Colour-leſs, makes it run up weak, and prevents the Impregnation of the Seeds.

Want of a ſufficient Quantity of Air and Light, more eſpecially prevent the Impregnation of the Seeds.

HEAT in a moderate degree, according to the Diſpoſition of the Plant, makes the Leaves flouriſh, and the Stem ſtrong, provided the Soil is ſufficiently moiſt; in a very great Degree it makes the Plant run up to Seed too ſoon, eſpecially in a dry Soil, and prevents the Growth of the Leaves.

Heat alſo prevents Moiſture from rotting the Roots, or any other Parts of a Plant; but it increaſes the Effects of moſt other Poiſons.

Plants are ſubject to HABITS, the principal of which are,

Firſt, The Seed's growing early in the Spring, and the Stems puſhing up ſoon to flower, and producing but a few Flowers: This is acquired by their having been propagated in a dry, ſandy, warm Soil.

Secondly, The Seed growing late, being long of puſhing up the Stem, ſo that there is often not Time for the Seed to ripen: This is acquired by their having been propagated in a moiſt, ſtiff, cold Soil.

Thirdly, A Diſpoſition to grow exceedingly ſtrong in all its Parts; in which Caſe too few Flowers are often produced: And this is acquired from their having been propagated in a very rich Soil.

Fourthly, Its Diſpoſition to grow weak, and produce ſmall Seeds, acquired from being propagated in a poor Soil.

Theſe affect the Graſſes particularly, ſo that it is frequently uſeful to change the Seed.

PART IV.

Of the NOURISHMENT of PLANTS.

A PLANT will grow in Sand alone, moiſtened with pure diſtilled Water, and in the pureſt Air, but not ſo luxuriantly as in a rich Soil.

A Plant will alſo grow better in a Mixture of Sand and Clay, where the Tenacity is adapted to the puſhing Power of its Root, than in Sand alone; and it will alſo grow better if a proper Quantity of Water be applied, according to the Diſpoſition of its Roots to reſiſt Putrefaction, but with both theſe Advantages, it will not flouriſh ſo well as in a rich Soil.

If in a proper Mixture of Sand and Clay, a Plant is properly ſupplied with Water, it will grow better than in the ſame Mixture expoſed to the Weather, and the Chances of being too moiſt or too dry; but it will grow ſtill better in a rich Soil.

There is therefore in a rich Soil ſomething independant of Texture, or the Retention of Water, which contributes to the flouriſhing of Plants.

A rich Soil contains Subſtances inſoluble in Water; or Subſtances ſoluble in Water.

The Subſtances inſoluble in Water cannot enter the Veſſels of the Roots of Plants, and therefore can only contribute either to the Texture, or the Production of Subſtances ſoluble in Water.

The Subſtances inſoluble in Water may neceſſarily only be Sand or Clay; thoſe at any Time found are,

Sand;
Clay;
Aſbeſtes Talc; &c.
Calcareous Earth;
Magneſia;
Earth of Allum;
Calces of Metals; particularly Iron and
  Copper; and
The Fibres of Vegetables.

Thoſe ſoluble in Water that are found in all rich Soils, are

- Mucilage;
- Nitrous Ammoniac;
- Nitrous Selenites;
- Common Ammoniac;
- Fixt Ammoniac;

Theſe Subſtances all get into the Plant along with the Water; and the Salts are found in the Juices of the Plant, unchanged.

A Mucilage is alſo found, but very different from that contained in Soils.

Therefore a Plant may be nouriſhed by pure Water and Air alone; but it will be more luxuriant, if it alſo abſorbs, and digeſts, a Quantity of Gelatinous Mucilage.

Richness of the Soil depends on

Firſt, A proper Degree of Tenacity, which is procured by

(*a*) A Mixture of Clay with Sand, or any other Earth, ſo that it ſhall contain between one Fourth of Clay, and three Fourths.

(*b*) Mucilage, which gives Friability to the Clay, and Tenacity to Sand.

(*c*) The Quality of the Clay, the more diffuſible it is in Water, it gives the better Texture to the Soil.

Secondly, The Quantity of Mucilage, the more there is in a Soil, the better.

One Grain in a Thouſand will be of Advantage, as it will give a ſenſible Tenacity to a ſufficient Quantity of Water, to moiſten the Soil thoroughly.

Thirdly, The Quantity of Subſtances capable of being converted in Mucilage.

(Vide Mucilage, Page 46.)

Fourthly, The Matters in the Soil diſpoſing theſe to be converted into Mucilage.

Theſe are,

Calcareous Earth;
Earthy Salts.

If a Soil be Rich, a ſmall Proportion of an Alkali, Neutral Salt, Cauſtic Calcareous Earth or Earthy Salt (except the Salts of Allum) will improve it, but theſe Subſtances, unleſs they be Putreſcents, hurt Plants growing in a poor Soil.

Theſe Subſtances may be ſaid to be *forcers*, in as much as they not only tend immediately to produce a large Crop, but deſtroy the Mucilage.

They may act by deſtroying the weak Fibres of the Roots, and occaſioning them to puſh out more numerous and ſtronger Ones.

They may prevent the Evaporation of the Water.

They may deſtroy Inſects.

Poſſibly, they may aſſiſt the Digeſtion of the Plant.

A very ſmall Proportion of them produces an Effect.

In manuring poor Soils, we are therefore to render them of a proper Texture, by adding Clay or Sand, where it can be done ſufficiently cheap, taking care that they be free from Pyrites, and it is to be obſerved, that leſs Clay will be uſeful in ſandy Soils, than Sand in Clay Soils.

FROST by the expanſive Power of the Cryſtallization of the Water, breaks down the Maſſes, which form in ſtiff Soils.

We are to apply Gelatinous Mucilage, or Subſtances from whence it may be formed, or Subſtances forwarding the Formation of it.

(Vide Mucilage, Page 46.)

Theſe are enriching Manures.

And in rich Soils, we may venture to apply the forcing Manures, as otherwiſe we ſhould not have the whole Effects of the Mucilage.

Any Defect of Texture may be made up by Mucilage, and the Alteration Clay undergoes on Culture, but the Defect of Mucilage cannot be made up by Texture.

A Soil, if it have all the Properties of a rich one, may have theſe counteracted by its containing poiſonous Subſtances, which are,

Firſt, Metallic Salts, or Pyrites.

Secondly, Salts containing Earth of Allum, (or Pyrites.)

Thirdly, Acids uncombined.

Fourthly, Any other Salt in too large a Proportion.

The firſt, ſecond and third may be deſtroyed by Quick Lime; the fourth is got the better of by Time, and the waſhing the Soil with Water, by the Rains, unleſs there be a freſh Supply from Springs.

The Advantages of draining a Soil, are the preventing the Water from

Rotting the Seeds.

Rotting the Roots, eſpecially at the Time of flowering.

Taking off the Effects of the Mucilage, by too great Dilution.

The Advantages of FALLOWING are,

The Converſion of the Vegetable Fibres into Mucilage, by deſtroying their Life, and expoſing them to the Air.

The deſtroying Weeds, by giving their Seeds an Opportunity of growing, killing them, and converting them into Mucilage.

The decompoſing Pyrites, and Metallic and Alluminous Salts.

A very poor Soil will be but little benefited by Fallowing, in as much as there is nothing contained in it capable of being converted into Mucilage, except the Rain Water, it is better to employ an enriching Crop.

Fallowing for ſeveral Years would deſtroy a Soil, as it would convert the whole putreſcent Subſtances into Mucilage, and that Mucilage into Salts, and theſe would be decompoſed.

The Advantages of DRILLING are,

The giving an Opportunity to deſtroy the Weeds, cut the Fibres of the Roots ſo as to make them branch out again, and looſen the Earth about the Roots, and throwing the Earth on the Stems, ſo as to make freſh Roots break out.

The ſaving ſuperfluous Seeds and ſowing the Ground more equally.

The giving a free Paſſage to the Air.

It is not yet determined how far the Rows ſhould be from one another, nor how thick the Plants ſhould be ſown; it will require that they ſhould be ſown thinner to produce a great Crop of Seeds, or Roots, than a great Quantity of Herbs.

Quere, Is there any Difference in the Direction of the Rows?

Enriching Crops are ſuch as ſupply the Soil with Matters capable of being converted into Mucilage, they do this

Firſt, By Exſudation from the Roots.

Secondly, By leaving the Roots, which will putrify.

Thirdly, If ploughed in, the whole Plant will putrify; and it is to be obſerved in this Caſe, that the Plants would always be cut down when in full Vigour, and while the Exſudation is ſtill taking Place ſtrongly.

If the Juices exſuded are very aſtringent, they counteract the good Effects of this Method of Culture by preventing the Putrefaction.

A Liſt of MANURES.

Firſt, Thoſe furniſhing Mucilage or Subſtances convertable into it.

As, 1, Glue,
2, Skins,
3, Hair,
4, Horns,
5, Bones,

6, Rags, &c. &c.

7, Dung of Animals,

8, Inſects,

9, Vegetable putrified Subſtances; theſe go through the Sacharine, Vinous, and Acetous Fermentations firſt; ſo that a Dunghill is not ſufficiently putrified, until the Heat is over; but it is better to putrify too little, than too much, as in the firſt Caſe, the Putrefaction may be continued in the Soil; in the ſecond, the Mucilage is converted into Salts, and cannot be reſtored.

Putreſcible Vegetable Subſtances: It is to be obſerved that Vegetable Subſtances that are of too ſolid a Texture, as Wood, putrify with great Difficulty into a Mucilage, and alſo thoſe that have aſtringent Juices, and ſuch as have lain in the Earth a conſiderable Time, and Sugar,

Enriching Crops.

Secondly, Manures converting putreſcible Subſtances into Mucilage.

1, Calcareous Earth, as

2, Marle,

3, Chalk,

4, Effete Lime:

5, Earthy Salts, in

a The Dung of Fowls, Rabbits, *&c.*

Too

b Too putrid Dunghills,
c Sea Water in ſmall Quantity,
Thirdly, Forcing Manures, as,
Quick Lime,
Fixt Alkalis in Vegetable Aſhes,
Neutral Salts which do not aſſiſt Putrefaction,
Earthy Salts as above.

Of INSECTS.

There are ſome Inſects which infeſt Vegetables when healthy, as the Inſect occaſioning the Smutt, or Blackneſs, in Grain: this Inſect is not deſtroyed by drying, but revives upon being moiſtened, and if ſown with the Seeds, will be propagated over the whole Field.

Q. Is this to be deſtroyed by ſteeping the Seeds in Solutions of Neutral Salts in Water?

Moſt Inſects attack Plants, in conſequence of a Weakneſs of the Plants themſelves; the Juices in that Caſe being converted into Sugar, become proper Nouriſhment for, and attract them, but when this happens, they afterwards hurt the Plant greatly.

Each Plant is infeſted by its particular Inſects,

PART V.

SUBSTANCES neceſſary for the *Examination* and *Analyſis* of SOILS, are,

FIRST, Vitriolic Acid,

Secondly, Muriatic Acid,

Thirdly, Solution of fixt Vegetable Alkali in Water.

Fourthly, Common Cauſtic, or Cauſtic fixt Vegetable Alkali.

Fifthly, Cauſtic Volatile Alkali, or Spirit of Sal Ammoniac with Quick Lime; it is known to be Cauſtic by not effervеſcing with an Acid.

Sixthly, Sal Ammoniac.

Seventhly, Galls.

Eighthly, Pure Water, if the Water contain any Metallic or Earthy Salt it is improper; to try this, pour into a Glaſs of it a few Drops of

Solution of fixt Vegetable Alkali in Water; if it be impure, the Alkali will precipitate the Metal or Earth; ſuch Water is to be purified by Diſtillation or Boiling.

PROCESSES for aſcertaining the Subſtances contained.

Proceſs Firſt, To aſcertain the Quantity of Water.

Take one hundred Grains of the Earth, ſpread it on a Stone Plate very thin before the Fire, or in the Sun-ſhine in a warm day, let it lie till it be thoroughly dry, the Water will evaporate, and therefore its Proportion will be known by the Weight loſt.

Secondly, To know if there be any Metallic or Earthy Salt.

Take about a Pound of Soil, pour upon it about a Pint of boiling diſtilled Water, ſtir them thoroughly together, and let them ſtand for ten Minutes, filter off the Water through filtrating Paper, pour into what comes through a little of the Solution of the fixt Vegetable Alkali in Water, if there be any Earthy or Metallic Salt, a Precipitation will take Place.

Thirdly, To know if the Salt contained has Calcareous Earth for one of its Elements.

Take the filtrated Solution, pour into it half an Ounce of Cauſtic Volatile Alkali, or continue to drop in this Alkali till no further Precipitation takes Place, afterwards filtrate it, and pour to what filtrates through, a little Solution of fixt Vegetable Alkali.; if there be any further Precipitation, it ſhows that there is an Earthy Salt conſiſting of Calcareous Earth for one of its Elements; if a Precipitation took Place upon the Application of the Cauſtic Volatile Alkali, it ſhows that there are either other Earthy or Metallic Salts.

Fourthly, To know if the Salt contained be Metallic or Aluminous.

Add to the filtrated Solution an Infuſion of Galls, if there be any Metallic or Aluminous Salt, a Precipitation will take Place, if Iron a purpliſh Black, if Copper, or Allum, a Grey.

Copper may alſo be diſtinguiſhed from Iron by falling in a blue Precipitate upon the Application of an Alkali, while Iron forms a Greeniſh, and Allum a White one.

Fifthly, To know if Magneſia be an Element of the Salt found.

Take the filtrated Solution, apply to it a Solution of Galls; if no Precipitation take Place, apply Cauſtic Volatile Alkali, which will precipitate the Magneſia if it be an Element of the Salt contained.

Sixthly, To know if a Neutral Salt be contained.

Evaporate the filtrated Solution with a boiling Heat, till the whole Water is nearly gone off, and let it ſtand to cool. If there be any Neutral Salt, it will cryſtallize.

Seventhly, To know if there be any Mucilage, and what Quantity.

Take thirty or forty Pounds of the Soil, boil it in ten Gallons of Water for an Hour, let the Earth ſubſide, pour off the clear Solution, afterwards add four or five Gallons of Water to the Earth, ſtir them thoroughly, let them ſtand to ſubſide, pour off the Water clear, mix it with the former, and evaporate the whole to dryneſs, putting it into a Water Bath towards the End of the Evaporation; what remains is the Mucilage, making Allowance for that part of the Decoction which was not waſhed out from the Earth, and deducting the Saline Subſtances which will cryſtallize if there be a conſiderable Quantity, but will be deſtroyed in the Operation if in ſmall Proportion, as they generally are.

Eighthly, To know if there be any Calcareous Earth in the Soil, and what Quantity.

Take one thouſand Grains of the dry Soil, apply to it half an Ounce of Muriatic Acid and four Ounces of Water in a Glaſs, Stone Ware, or Porcelain Veſſel, ſufficiently large; let them ſtand together till no more Effervеſcence takes place and if it was very conſiderable, pour in half an Ounce more of the Acid, let this ſtand alſo till the Effervеſcence ceaſes, if any aroſe upon pouring it in, continue to add more Acid in the ſame Manner, until what was poured in laſt, produces little Effervеſcence, which is often at the firſt, and generally at the ſecond or third half Ounce.

After the Effervеſcence has ceaſed, put the whole in a Filter, let the Solution filtrate through; pour half a Pint of Water upon what remains in the Filter, let that filtrate alſo in the ſame Veſſel; add to the Solution thus filtrated an Ounce and an Half of Cauſtic Volatile Alkali for every Ounce of Acid uſed; if any Precipitation take Place, there is Magneſia, Earth of Allum, or the Calx of a Metal (generally Iron or Copper) contained in the Soil; after adding the Volatile Alkali the whole is to be thrown into a Filter again; after the Filtration has taken Place, pour into the Liquor a Solution of mild fixt Vegetable Alkali in Water; if there be any Calcareous Earth in the Soil, a Precipitation will take Place; continue to add the Solution of the Alkali till no freſh Precipitation enſues, throw the whole into a Filter, let the Liquor filtrate off, pour on by Degrees a Pint of Water, let that filtrate off alſo, dry what remains in the Filter, it is the Calcareous Earth.

Ninthly, To know the Proportion of Sand and Clay.

Take what remains in the Filter after the firſt Solution in the foregoing Operation, and by Elutriation ſeparate the Sand from the Clay, dry and weigh them: If there be any Pyrites it will appear in the Sand.

In the above Proceſſes the principal Things to be attended to, are,

Whether there be any Metallic, or Alluminous Salts, as theſe are abſolute Poiſons, and therefore are to be decompoſed by Quick Lime.

Whether there be ſuch a Proportion of Neutral or Earthy Salts as to be hurtful, in which Caſe, the Solution in *Proceſs* (Second,) will taſte Salt, a Soil containing them in ſo large a Proportion, will hardly ever admit of Culture for Grain.

Whether there be Calcareous Earth, and in what Proportion, as that aſcertains the Propriety of applying any Manure containing it, and the Quantity of that Manure.

What the Proportion of Sand and Clay is which aſcertains the Propriety of adding Sand or Clay.

Whether there be Pyrites as that ſhows why, and when a Soil will be long of being brought into Cultivation.

Pyrites are beſt deſtroyed by Fallowing, and afterwards applying Lime.

EXPLANATION of the PLATES.

FIG. I.

FROM Experiment it is ſound, that Bodies upon cooling contract and retain their Shape; therefore that they contract in every Direction.

Suppoſe A A A B B B to repreſent the Section of a Sphere, the Diameters A B upon the Sphere's being cooled, become equally ſhorter in all their Parts; but if the Particles lying in the Direction of theſe Diameters touched, they could not come nearer, and the Diameters could not contract, it is evident that the Particles do not touch.

FIG. II.

The Particles O O of the Oil, attracting one another ſtronger than they do the Particles W W, *&c.* of the Water, form a Globule G G, ſurrounded by the Particles W W, &c. of the Water.

FIG. III.

The Particles S of the Serum, attracting the Particles W of the Water, as ſtrongly as they do one another, they intermix together equally.

F I G. IV.

Suppoſe N a Sphere of Iron immerſed in Water, it would be ſurrounded by the Particles of Water W W, *&c.* in order to ſink through the Water it muſt ſeparate the Particles D D from one another, and therefore muſt overcome their Attraction, and it muſt ſlide along the Particles C B and therefore that Friction muſt alſo be overcome. If therefore the Difference of ſpecific Gravity ſhould not be ſufficient to overcome theſe Reſiſtances, the Sphere would ſwim. But the reſiſtance of the Attraction of the Particles D D will be the ſame nearly in a large and a ſmall Sphere, and the total Difference of the Gravity of a ſmall Sphere and an equal Bulk of the Fluid, will be leſs than the total Difference of the Gravity of a large Sphere and an equal Bulk of the Fluid; if therefore you could diminiſh the Sphere until that Difference is leſs than the Attraction of the Particles D D it would ſwim.

F I G. V.

As the Particles of Bodies do not touch but adhere by Attractions, and Repulſions, they may be conſidered as acting at the Sphere, where their Attractions are in Equilibrio. If there be four Particles P P P P, they may be conſidered as producing their Effects at the Spheres A A A A,

FIG. VI.

When two Particles P P are chemically combined, they may be conſidered as united at the chemical Sphere of Action C, and now to have acquired one common Sphere of Mechanical Action M, their former Spheres of Mechanical Action being loſt during their chemical Combination.

FIG. VII.

Thus a Particle of Volatile Alkali, may unite chemically with a Particle of an Acid, forming Sal Ammoniac, in which they have one common Sphere of Chemical Attraction, at which they may unite with Copper, and when ſo combined, the three Particles acquire one Sphere of Mechanical Action.

FIG. VIII.

Subſtances evaporate more or leſs readily according to the Preſſure on their Surface; ſuppoſe therefore, that a Fluid conſiſts of Rows of Particles A B C, the upper Row A has only the Preſſure of the Atmoſphere, but the next Row B, has both the Preſſure of the Atmoſphere, and the Preſſure of the upper Row, therefore the upper Row A will evaporate moſt readily, and as boiling Fluids are heated equally, and it will require a greater Heat to evaporate the Row B than the Row A, the whole Evaporation will take place from the Surface.

APPENDIX

FOR THE USE OF

PRACTICAL FARMERS.

THERE are Five Earths, *viz.* 1ſt, Sandy. —2d, Clay.—3d, Magneſia.—4th, Earth of Allum.—5th. Calcareous Earth.—The Three laſt are called Abſorbent Earths.—The Magneſia and Earth of Allum are ſeldom found in Soils uncombined with an Acid Subſtance. Earths.

The Calcareous Earths are *Marle,* of all Sorts, *Limeſtone*, *Chalk,* Marble, and the Earth formed of the Bodies of all Animals, ſometimes called Animal Earth : Moſt Calcareous Earths are ſuppoſed to be formed originally from Shells.

Sand, Clay and Water, form within a mere Trifle of what we call Earth or Soil; for any other Ingredient that may be therein are in a mighty ſmall Proportion to the Sand, Clay and Water.—Theſe are the great compotent Parts, whatever Colour or Texture the Soil may happen to have.

Mucilage is a Subſtance which is converted into the Nouriſhment of all Plants whatſoever; it is formed from the Putrefaction of Animals or Vegetable Subſtances; it is formed alſo from Dung from Dew—or Rain-water putrified.—Plants, Mucilage.

while their Leaves flouriſh, diſcharge Juices from their Roots capable of being converted into a Mucilage.—The Succulent Plants, ſuch as, Peaſe, Beans, Turnip. Cabbage, &c. yield much Matter for Mucilage to the Ground.—Quick-Lime, and rolling the Ground with a heavy Roller, deſtroy numberleſs Inſects, which afterwards putrify, and yield Matter for Mucilage.

Mucilaginous Juices--are of two Kinds,--*One*, when diſſolved in Water forms a Sort of Jelly, and is an immediate Manure.—Moſt Animal Subſtances are of this Sort.—The *Other* Kind diſſolved in Water makes a Gummy Liquid as Sugar does.—This Kind muſt putrify before it becomes a Manure.—Moſt Vegetable Subſtances are of this latter Kind.

Putrefaction has two Stages.—The Firſt converts Animal or Vegetable Subſtances into a Mucilage.—The Second converts that Mucilage into one, or, more Species of Salt.

How Marle or Lime benefit or exhauſt Land.

Marle, Lime, or any other Calcareous Earth applied to Land, acts in this Manner.—They haſten the Putrefaction of all Putreſcible Subſtances in a Soil,—conſequently, if there be not added at leaſt a proportionable Quantity of Dung, well mixed, containing Mucilage, they muſt infallibly exhauſt Land ;—for they convert all the putreſcible Matter therein to Mucilage, much ſooner than it would be otherwiſe converted :—This will at firſt make the Land produce much greater Crops than uſual, there being ſo much additional Food prepared for the Plants; but after one, two, or three Years at moſt, thoſe heavy Crops will have conſumed moſt Part, if not all the Mucilage; and the little that may remain is converted into Salts, by the ſecond Stage of Putrefaction as above-mentioned, which Salts in a little Time are rendered of no Effect, or if they have any Effects, they are hurtful to Vegetation, if without Mucilage, and by this Means, the Soil becomes quite exhauſted, and a mere Caput Mortuum.—Another Benefit Lime, *&c.* yield to Land is, That if there be an Iron, Copper, or Sulphur (which are poiſonous to Plants) diſſolved in the Acid Juices of the Soils, Lime, Marle, *&c.* will attract that Acid, and let go the Iron, *&c.* which, when become ſolid in a Heap, can do no Harm to Land.

The Remedy for Land exhauſted by Lime, *&c.*

Plough the Land as deep as poſſible, ſo as to bring up a new Body of Mould before Winter; then *Fallow* it well the enſuing Summer and Autumn, that every Part of it may be expoſed to the Winter and Summer Air; dung it ſtrongly, then ſow a Crop of theſe Plants that yield moſt Mucilaginous Matter (as above-mentioned) and before their Leaves have done flouriſhing, plough in that Crop.—If this be done exactly as here deſcribed, the Land will acquire a new Stock of Nouriſhment, and come into good Heart again;

Properties of Mucilage.

Diſſolved in Water, and applied to Plants, it makes them grow Luxuriant.—In a moiſt Soil, it jellies the Water, and prevents it from ſoaking through the Sides of the Roots of Plants.—In a dry Soil it prevents the Water from being exhaled; it gives Tenacity to a Sandy Soil, and Friability to a Clay Soil: It is converted into the Juices of Plants, and nouriſheth them.

Proportional Parts of a good Soil.

It is preſumed they may be as follows.—Either One-fourth Sand, and Three-fourths Clay:—Or Three-fourths Clay, and One Sand: this is including Water, Calcareous Earth, Mucilage, Salts, &c. in the Maſs of Earth you examine:—For Inſtance,

In 400 Grains of Good Soil, there may be,

Sand,	Clay,	Water,	Calc. Earth,	Mucila.	Total.
72 or 219	219 or 72	100	7	1	400

N. B. The Quantity of Mucilage to do real good to a Soil, muſt bear a certain Proportion to the Quantity of Water, as in the above Inſtance, there is *one* Grain of Mucilage to 100 Grains of Water.—Hence obſerve, the Neceſſity of thoroughly draining Land; for if there be the greateſt Quantity poſſible of Mucilage in your Soil, yet, if the Water ſhould exceed its due Proportion, all the Mucilage is loſt, and of no Effect, by the Mucilage not having the

Power to give the neceſſary Degree of Tenacity and Conſiſtence to the Water.

Manures are of two Kinds.

Manures are of two kinds. *One* adds Nouriſhment to the Soil, as all Animal and Vegetable putreſcible Subſtances from whence Mucilage can be found.—The *Other* gives no Nouriſhment to the Soil but forces it, by preparing the Nouriſhment already there.

Forcing Manures are of two Kinds.—One reſiſts Putrefaction, the other forwards it:—That which reſiſts, is ſeveral Sorts of Salt in the Aſhes of burnt Vegetables, in Soot, Dung of Fowls, ſome in Horſe Dung, if it be not too putrid, and in Sea-Water, *&c.*—Alſo Quick-Lime is a Reſiſter of Putrefaction;—the Way in which theſe act, is to kill the weak Fibres of Plants, and thereby force them to ſhoot out ſtronger Ones; they alſo facilitate the Digeſtion of Plants; they diſſolve in Water, and prevent it from evaporating too eaſily; they deſtroy Inſects.

The other Sort of Forcing Manures which forward Putrefaction, are certain Salts formed from Calcareous Earth, and Spirit of Sea Salt, or Oil of Vitriol.—All Marle, or Lime-ſtone, ſix or eight Months after being burnt, ſorward Putrefaction, and turn all putreſcible Matter in a Soil into a Mucilage; likewiſe Dung over-putrid is a forcing Manure, that forwards Putrefaction from the Salt in it.

N. B. Lime when burnt diſcharges all its fixed Air, but after five or ſix Months it imbibes again the fixed Air, and reverts to its former State of unburnt Lime.

From what has been ſaid with Reſpect to the Action of Marle, and all Calcareous Earths, it will plainly appear, that if there be little, or no putreſcible Matter in a Soil to convert into Mucilage, it can have no effect at all (except to prevent the poiſonous Effects of Metal) on the Land.

Salts are not converted into the Nouriſhments of Plants as Mucilage is; the richer the Soil the more Effects it will have.—As to all Acid and Metallick Salts, and Salt of the Earth of Allum, they are poiſonous to Plants.

Fermentations in a Dunghill.

Fermentations in a Dunghill are Five.—The *Firſt* makes the Juices ſweet;—the *Second* makes them Spirituous like Wine;—the 3d, Sour like Vinegar;—the 4th and 5th, are of the putrefactive kind above-mentioned.—During the three firſt, the Dunghill heats, but when the 4th, or Mucilaginous Putrefaction begins, the Mucilage forms, and the Dunghill grows cold (that is the proper Moment for laying the Dung upon the Land, though it is better to lay it on too ſoon than too late) after this, the laſt Fermentation begins, in which the Mucilage is converted into Salts.—Great Care ſhould be taken, by frequently mixing the whole Maſs of Dung well together, that every Part of it may as far as poſſible, be in the ſame Stage of Fermentation, leſt ſome ſhould arrive at the laſt Stage, *viz.* theSelts, before the other Parts are become Mucilaginous.—This happens very frequently, where Dung and Lime are laid in Strata in a Dunghill, and not well mixed throughout the Maſs, much of the Benefit of it is thereby loſt.

Plants.

Moſt Plants uſed in Agriculture, that do not branch out at the Side above Ground, generally do it below Ground, as all Corns and Graſſes do. —Feeding Corn, or bruiſing the Tops of it with a Roller, makes it branch out below Ground.

All Perennial Graſſes continue ſuch, by branching out anew every Year, for the old Root always dies.

Whenever a Plant becomes weak, its Juices are converted into Sugar, which allures Inſects to come, and lay their Eggs there; hence Blights, *&c.*

Plants abſorb Nouriſhment by their Leaves, as well as by their Roots; and whilſt their Leaves are flouriſhing, they diſcharge into the Ground a Part of their Juices; and until they begin to flower, they diſcharge a greater Quantity than they receive from the Earth, conſequently till then they enrich the Ground.—Plants that have lateral Flowers, ſuch as Peaſe, Lupins, *&c.* continue to flouriſh during all the Time of Flowering, which is till the Seed is ripe.—Plants that have terminal Flowers, as Corn and Graſſes, have their Leaves wither by Degrees in a few

Days, as the Flowering advances, and from that Period they abſorb all their Nouriſhment from the Ground to perfect their Seed, and yield no Nouriſhment to the Ground.—Seeds taken from Plants in a rich Soil, branch out more than thoſe taken from Plants in a poorer Soil—No Plant robs another of the Food it takes in by the Root; but, on the contrary, gives it more Food; for the Ground is kept the moiſter, the more Plants there are; but Plants by being too cloſe rob one another of what they receive from above, *viz.* Air, Sun, Dews, Rain, *&c.*

There is always the greateſt Crop of Hay if cut when the Flowering begins to open, for then there is a greater Quantity of Nouriſhment in the Plants, than either before, or after that Period.

Ploughing.

Amongſt the numberleſs Advantages that attend a thorough Ploughing, *&c.* pulverizing of the Soil, there are two moſt certain; one is, that if there be any poiſonous Qualities in the Soil, ariſing from Metals or Sulphur, you infallibly deſtroy them, by turning them up to the Air.

The Second is, that you open the Way for the Fibres of Plants to go in Queſt of their Food, and thereby render them ſtrong and vigorous.

FINIS.